

Power supply installations for passenger stock

Installations pour l'alimentation en énergie électrique du matériel à voyageurs

Elektrische Energieversorgungseinrichtungen für Wagen der Reisezugwagenbauart



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The person responsible for this leaflet is named in the UIC Code

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Summary

This Leaflet applies to any passenger stock in generalised use in international traffic.

This Leaflet includes the general provisions with which power supply installations must comply, irrespective of their design.

The provisions for electrical switch cabinets on passenger stock are laid down in *UIC Leaflet 550-1*.

The conditions for type testing the power supply systems of passenger coaches are set out in *UIC Leaflet 550-2*.

The limit values for the effect on electrical installations outside passenger coaches are contained in *UIC Leaflet 550-3*.

1 - Principles

- 1.1 - Each coach shall be fitted with a train line as specified in *UIC Leaflet 552* (see Bibliography - page 34).
 - 1.2 - Each coach shall be fitted with a storage battery and a battery charger in order to ensure that the lighting installations and other essential circuits continue to run should the power supply be cut.
 - 1.3 - Electrical loads and in particular the converter equipment to be supplied with power from the train line, shall be so designed that any interference they may cause remains within the limits defined in *UIC Leaflet 550-3* (see Bibliography - page 34) so that they do not disrupt the operation of installations outside the vehicle.
- 1.4 - The equipment connected to the train line needs only to be designed for the nominal voltages at which train line can operate.

2 - Battery and battery chargers

2.1 - The nominal voltage of the battery and the d.c. circuit shall be 24 V. A voltage of 110 V is authorised for sleeping cars and dining cars.

The tolerances on the voltage shall correspond to the provisions of standard *EN 50155* (see [Bibliography - page 34](#)).

2.2 - Converters which take their power from the train line shall be used as battery chargers.

2.3 - The battery chargers which charge coach batteries for long periods when the vehicle is stationary must be designed to preclude any possibility of the battery becoming overcharged thus creating the risk of an explosion.

2.4 - The battery charge voltage shall be regulated in accordance with the temperature of the battery.

2.5 - As a safety measure, the capacity of the battery shall be such that at least the provisions of point [2.6.2](#) should be observed during an interruption of the battery charge.

When assessing the capacity of the battery account should be taken of loss of battery capacity due to natural ageing and the operation of the vehicle at low external temperatures according to the climatic zones stipulated in *UIC Leaflet 553, Appendix 3* (see [Bibliography - page 34](#)).

2.6 - In order to save the energy stored in vehicle batteries and allow the important units to operate for as long as possible when there is no battery charge, the following measures should be applied:

2.6.1 - The various units shall be progressively disconnected depending on the importance of their function by a minimum voltage relay.

2.6.2 - If there is no battery charge, battery consumption shall be reduced to a minimum in order to guarantee the following functions:

- the emergency lighting as specified in *UIC Leaflet 555*
- the starting of the power supply equipment as soon as the high voltage supply resumes as specified in [Point 3 - page 5](#)
- the electromagnetic brake as specified in *Leaflet UIC Leaflet 541-06*
- the electronic wheel slide protection as specified in *UIC Leaflet 541-05* minimum 5 hours
- the control of the doors as specified in *UIC Leaflet 560* minimum 5 hours
- the public address system as specified in *UIC Leaflet 568*
- the data transmission equipment as specified in *UIC Leaflet 556* minimum 5 hours
- the emergency ventilation as specified in *UIC Leaflet 553*
- other important control and monitoring systems
(for example control of the WCs and fire warning system).

2.7 - The main circuit of the on-board d.c. system shall be protected on both its poles. It must be possible to cut secondary circuits on both poles with current monitoring carried out at least on the positive pole.

2.8 - The on-board d.c. system should be insulated from the vehicle earth.

It is recommended that the on-board d.c. system be insulated from the vehicle earth by means of an appropriate device. Any insulation defects should be signalled in accordance with *UIC Leaflet 550-1* (see Bibliography - page 34).

3 - Connection of the electrical power supply after a prolonged period of immobilisation without power

- **3.1** - When vehicles are equipped for central supply from the train line through corresponding power-supplying installations, they must be able, even after a prolonged period of immobilisation with no external power supply, to restart and provide sufficient energy for all equipment as soon as HT power is restored to the train line.
- 3.2** - The requisite power may be available from any of the following sources:
 - directly from the HT line or,
 - from the coach battery or,
 - from an auxiliary battery.
- **3.3** - If batteries are the energy source, they must be able to provide the necessary power for 5 successive restarts.
- **3.4** - The auxiliary battery shall only be used to restart the power supply equipment and shall not be connected to the coach circuits.

4 - Electrical loads connected to the train line

- **4.1** - Electrical loads connected to the train line shall be designed to operate satisfactorily within the voltage range of between $U_{\max 2}$ and $U_{\min 1}$ as set out in Appendix **B** - page 23 and shown in *UIC Leaflet 600* (see Bibliography - page 34).
- **4.2** - Possible distortion of the waveform should be taken into account. In the case of alternating current, the ratio between the root-mean-square value and the peak value may be 1:2. In the case of a d.c. voltage, this is a unidirectional three phase current without smoothing.
- **4.3** - The equipment may stop working when the voltage is outside the $U_{\min 2}$ - $U_{\max 2A}$ range; however, the equipment should start up again once the voltage has returned to the $U_{\max 2}$ - $U_{\min 1}$ range.
- **4.4** - For hauled stock supplied with electrical power by diesel tractive units or generator vans through the train line, the conditions to be met regarding voltage and frequency are those set out in *UIC Leaflet 626* (see Bibliography - page 34).
- **4.5** - Railways may require that coaches be suitable for running in accordance with *UIC Leaflet 626*, when the coaches concerned are worked on lines where the operating conditions so dictate.
- 4.6** - Nominal voltage of 1 500 V:
 - 4.6.1** - It is recommended that frequency variations of between 16 and 52 Hz should be taken into account.
 - **4.6.2** - Railways may require that coaches be suitable for working with frequency variations of between 16 and 52 Hz if the train line is energised through the electrical power generators in diesel tractive units.
- **4.7** - Railways may require that with a nominal voltage of 1 000 V coaches be suitable for working with frequency variations of between 21 and 23 Hz, if the train line is energised through the electrical power generators in diesel tractive units.
- **4.8** - Current-consuming equipment connected to the train line must adapt automatically to the different voltages.
- **4.9** - Each vehicle shall be fitted with an isolating and earthing switch that allows all equipment connected to the train line to be disconnected on load with one single action. The position of this device shall be marked as shown in Appendix **D** - page 26. The disconnection and earthing equipment shall be operated by means of a Berne key as specified in *RIC, Plate 3* (see Bibliography - page 34).

Other technical and design requirements that apply to the disconnection and earthing equipment are given in point **16** - page 19.
- **4.10** - Each vehicle shall be fitted with a switch in the electrical cabinet as shown in *UIC Leaflet 550-1* that enables all the electrical equipment to be disconnected from the train line in a single operation. This switch shall have a danger sign as shown in Appendix **E** - page 27.

- **4.11** - Breaks of short duration, resulting from loss of pantograph contact, shall not lead to a power cut or to switching of the equipment.
- **4.12** - Electrical equipment in a coach which causes current peaks on connection and is connected to the train line, must be designed in such a way that, when the train line is energised, the appliances concerned are not all activated simultaneously in all coaches but at different times.
- **4.13** - When a current-consuming appliance is switched on, the first current semi-wave must not exceed 180 A for a sinusoidal voltage of 1 000 V and 16 2/3 Hz. However, the purely inductive part must not be higher than 40 A.
- **4.14** - Regardless of the train line's nominal voltage, the inrush current of all static converters of a coach connected to the train line must not exceed 180 A.
- **4.15** - Power factor λ :
 - 4.15.1** - Power transformers in coaches should be reactionless, from the point of view of reactive power via the train line.
 - 4.15.2** - When the train line is supplied by an electric tractive unit which has a sinusoidal voltage shape, the power factor λ , based on the maximum power allowable for a coach according to point 5 - page 8, shall not be less than 0,85 t.
 - 4.15.3** - If the train line is supplied by a diesel locomotive or a generator van with a trapezoidal or rectangular voltage shape, the power factor λ shall not be less than 0,9 up to 20% of the nominal rating of the power transformation installation as specified in point 5 and shall not be less than 0,95 for a higher power.
- **4.16** - If the train line is supplied by a diesel locomotive or generator vans with a trapezoidal or rectangular voltage shape, the design of the transformers connected directly to the train line shall comply with the following conditions:
 - the magnetising current must not exceed 0,8 A,
 - the working point on the characteristic magnetisation curve shall not exceed 50% of the saturation induction,
 - the ohmic resistance of the primary winding should be between 1 and 2 Ω .
- **4.17** - Electrical equipment connected to the train line must not have a capacitive effect.
- **4.18** - Electronic power devices in coaches supplied by transformers connected directly to the train line (e.g. battery chargers, converters and inverters) shall not have a controlled or semi-controlled input stage.

5 - Permissible energy consumption of a coach and of a trainset

5.1 - The provisions relating to the power drawn by a vehicle from the train line are defined from the dimensions in *UIC Leaflet 567* (see [Bibliography - page 34](#)).

5.2 - The permissible energy consumption of a coach S_W shall not exceed the values shown in Appendix [C.1 - page 24](#). The energy consumption is mainly influenced by the external temperature and the thermal insulation of the coach.

5.2.1 - Continuous operation: this is the situation when coaches have reached a steady state, where temperatures in the passenger compartments have attained their theoretical levels and the equipment is functioning within the range of values set.

5.2.2 - Start-up: this is the situation when the temperatures inside the passenger compartments have not yet reached their theoretical levels. The vehicles are still in a preheating or precooling phase; the batteries are almost flat. For a period of one hour after the train line has been energised, the energy absorbed may exceed by 10% that attained in continuous operation.

5.2.3 - The mean power absorbed by a coach is obtained by dividing the energy consumption in any given period by that same period.

5.3 - The maximum power absorbed by a coach corresponds to the sum of the powers of all the electric loads connected to the train line. The ratio between the mean power and the maximum power of a coach can be 1 : 1,1.

5.4 - The current taken by the power supply equipment from the train line shall not exceed the current allowed at U_n for $U < U_n$ (U_n = Nominal voltage in accordance with Appendix [B - page 23](#)).

5.5 - The average power of the electrical equipment in the dining car galley, taken from the train line, shall not exceed 50 kVA.

5.6 - The power for the pressure ventilation equipment of coaches with fans, taken from the train line, shall not exceed 10 kVA.

5.7 - The energy consumption on the train line of coaches whose dimensions differ from those specified in *UIC Leaflet 567* (e.g. double decker coaches), may be different to point [5.2](#), provided the conditions laid down in point [5.8.2](#) are complied with.

5.8 - The maximum permissible power absorbed by a 15 coach trainset S_z , including a dining car, can be calculated from points [5.1](#) to [5.6](#). It is shown, as a function of the external temperature, in Appendix [C.2 - page 25](#).

5.8.1 - For continuous operation and start-up, the definitions given in points [5.2.1](#) and [5.2.2](#) shall apply.

5.8.2 - The maximum permissible power absorbed by a trainset, as specified in Appendix [C.2](#), shall remain the same regardless of the dimensions of the coaches. This limit must be heeded when forming train consists with coaches as per point [5.7](#).

6 - Voltage peaks on the train line

6.1 - Definition of voltage peaks: voltage peaks may be superimposed on the nominal voltages as specified in point **4.1 - page 6** and Appendix **B - page 23** with their voltage tolerances. Their shape and duration may be as follows:

6.1.1 - Low voltage peaks with a slow increase but of a duration greater than 20 ms.

6.1.2 - Recurring voltage peaks, in the case of alternating voltages, of a duration greater than 20 ms.

6.1.3 - Very high level voltage peaks, non-recurring, lasting less than 20 ms for a period exceeding 20 ms.

6.2 - Appendices **F.1 - page 28** to **F.4 - page 31** show the maximum permissible values for voltage peaks in terms of time (logarithmic scale) for the different nominal voltages. The voltage values of $U_{\max 1}$ to $U_{\max 4}$ are also included. The peak values permissible for alternating voltages are also given in Appendices **F.3 - page 30** and **F.4**.

6.3 - The limit values $U_{\max 1}$ to $U_{\max 4}$ are listed in the form of a table in Appendix **F.5 - page 32** (see Appendix **B - page 23**).

6.4 - Energy content of the voltage peaks: to be added later.